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Japanese Published Unexamined (Kokai) Patent Publication No. 53-139754; Publication Date: December 6, 1978; Application No. 52-053438; Application Date: May 10, 1977; Int. Cl.[2]: A23B 4/14; Inventor(s): Hisateru Mitsuda et al.; Applicant: Jipcom Corporation; Japanese Title: CO2 niyoru Sengyo no Hozon oyobi Chozou Houhou (Method for Preservation and Storing of Fresh Fish by Carbon Dioxide [$CO_2$])

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Specification

1. Title of Invention

Method for Preservation and Storing of Fresh Fish by $CO_2$

2. Claim

Method for preservation and storing of fresh fish by $CO_2$, characterized in that captured live fish are supplied in a water tank with $CO_2$ dissolved underwater in advance; $CO_2$ is supplied into the fish body by a circulation of the blood using a respiration of the fish per se; by coagulating $CO_2$ in protein contained in and adhered on all protein containing substances in the organs and the muscles, the condensation of $CO_2$ in the fish body is made to gradually increase to induce hibernation; the temporarily dead fish are supplied into a sealed container; by newly blowing $CO_2$, it is permeated from the outer surface of the fish body to obtain a complete bonding between $CO_2$ and protein from the inside and outside the fish body in a short period.

3. Detailed Description of the Invention

In the case of large fish such as bonito and tuna, the body temperatures are higher than the environmental water temperature by several degrees. It is known that during a

capturing of the fish, the body temperatures further increase by agitation of the fish bodies. The cause of the heat generation by the agitated fish bodies (the temperature of the fish bodies is 30°C when the water temperature is 20°C) is assumed to be a heat generated by decomposition of glycogen or adenosine triphosphate inside the fish bodies. As the amount of glycogen is high in the fish bodies, the tendency of the heat generation is significant.

In order to prevent the deterioration of the quality of the fish at the aforementioned conditions as much as possible without losing the freshness, a storing with ice by a precooling, a storing with water and ice, a storing with cooled seawater and a freeze storing are practiced. Since these methods are used for solving the problem based on the physical aspect alone, the basic problem has not been solved yet. On the other hand, in a thought based on experiences, at a process after a landing of fish, the storing temperature is generally ideally at about 10°C rather than 0°C as the death rigor delays. The storing limit is 18 hours after the process, which cannot be clarified unless a study in the biochemical field is incorporated.

At fish types that are raw materials of fish cake, such as Alaska Pollack, when they are put to a freeze process as they are, the elasticity and the bonding force are lost due to denaturing of protein. As a result, the fish types do not meet the forming conditions for kamaboko (Japanese fish cake) to lose the product values.

In any ways, the meat of frozen fish hardens whereas a drip effect occurs thereto to deteriorate the product quality. These effects are also caused by denaturing of protein and said to occur by the freezing speed and the storing temperature.

As a result of storing codfish and Alaska Pollack by a freeze means, the fish meat becomes a sponge state. This effect is said to occur by freezing unfrozen water pushed out of the cells as a free gas expands along with a freeze of water in the cells as a large amount of water and a large amount of a nitrogen gas are contained in the fish meat.

(A part of a research report on "Advancement and Issues of Food Technology" in White Paper on Food Economics [1976 ed. by Agricultural Politics Study Center Foundation] by Masamichi Ofuji is quoted in the above description.)

The speed in the deterioration of the quality of protein during a storing is generally slower than that of other nutrient such as fats and vitamins. Protein deteriorates while being affected by numerous outer elements such as the temperature during a storing, the humidity, light, enzymes, copresented substances (sugar, fats, metals, etc.) and microorganisms. Primary denaturing types are discoloration derived from oxidation of an aromatic group and an amino acid residue and a physical change (the deterioration of the dissolution, the coagulation, the water retaining property or the like) derived from the reaction of various soluble groups including an amino group, a S.H. group and a carboxylic group. When sugar, fats, vitamins and metals are copresented, the denaturing becomes significant to incur a strong discoloration to brown (an amino carbonyl reaction), a strong change in the viscosity, a liberation of ammonia, a production of toxic peptide amines due to a cutting of protein, resulting in an undesirable result on the food process and production. When the amount of water contained is high, the food is contaminated by microorganisms to rapidly accelerate the denaturing.

(A part of theoretical points in a denaturing prevention for protein by a carbon dioxide condensation method as disclosed in Japanese unexamined patent application No. 51-101148 is quoted in the above description.)

The basis of the preserving and storing method for fresh fish of the invention is to prevent a change and putrefaction in the storing of fresh fish by cutting the contact between various outer elements (microorganisms, active gases, metals, organic substances and other elements) and protein by condensing a slight amount of $CO_2$ in protein molecules. Various functional groups in the protein particles are protected because of $CO_2$ condensed in the stored protein to prevent the deterioration of the stored protein.

The first characteristic of the invention is to uniformly condense $CO_2$ in protein in each tissue of the fish body by sending it to the terminal with the capillary tubes by circulating the blood for a specific period using the respiration of the fish per se so as to permeate $CO_2$ in each tissue of the fish body gradually and quickly while captured live fish is being released in water with $CO_2$ dissolved in advance. Thereby, $CO_2$ can be condensed in protein in microorganisms copresented inside the fish body as well. When $CO_2$ reaches a specific concentration in the fish body, the live fish loses the consciousness so as to fall into hibernation.

At the next step, the fish body is supplied in a container sealed at a specific level or plastic film bag to seal a predetermined amount of $CO_2$ into the container or bag, which is the second characteristic of the invention. Thereby, the conditions for preservation and storing are prepared by completing the condensation of $CO_2$ in protein by introducing $CO_2$ from the inside and outside of the fish body via gaps of the cells.

It is possible to send the fish body processed by the method of the invention to a desired location by transporting it at a low temperature as it is for a short-term preservation for about one week. In the case of a long term preservation, by controlling a refrigeration and freeze period at 0 or lower °C as needed, the previous disadvantages mainly caused by denatured protein are entirely eliminated. Thereby, it is an effective preserving and storing method that can keep the freshness of the fish body.

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Japanese Published Examined Patent Application (Kokoku Koho) No. 55-006337, Patented Date: February 15, 1980; Application No. 52-053438; Application Date: May 10, 1977; Publication No. 53-139754; Publication Date: December 6, 1978; Int. Cl.[3]: A23B 4/00; Inventor(s): Hisateru Mitsuda et al.; Applicant: Jipcom Corporation; Japanese Title: $CO_2$ niyoru Sengyo no Hozon oyob Chozouhou (Method for Preservation and Storing of Fresh Fish by $CO_2$)

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Claim

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substances and other elements) and protein by condensing a slight amount of $CO_2$ in protein molecules. Various functional groups in the protein particles are protected because of $CO_2$ condensed in the stored protein to prevent the deterioration of the stored protein.

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The working example of the invention is described next in detail. Type of fish to be used: carp (41.0 cm in length; 786 g in weight); water tank: 3 (vertical) x 38 (horizontal) x 21 (depth) cm; amount of water: 15 ℓ; water temperature: 10°C; CO2: 1.0 ℓ/min. When $CO_2$ is blown into the water tank as described above, activities as indicated in the table below occur to the carp.

| Testing period (minutes) | pH | Number of respirations (per minute) | Concentration of dissolved oxygen (ppm) | Observation |
|---|---|---|---|---|
| [Please refer to the original description] | | | | Still<br>Actively swimming<br>Turned sideways (a dormancy state)<br>Respiration stopped |

Type of fish to be used: yellow tail (480 cm; 1800 g); water tank: 42 x 63 x 36 cm; seawater tank: 34 ℓ; water temperature: 15°C; $CO_2$: 1.0 ℓ/min.

The yellow tail also demonstrates activities as indicated in the table below.

| Testing period (minutes) | pH | Number of respirations (per minute) | Concentration of dissolved oxygen (ppm) | Observation |
|---|---|---|---|---|
| [Please refer to the original description] | | | | Still<br>Actively swimming<br>Begins to turn sideways<br>Completely turned sideways (a dormancy state)<br>Respiration stopped |

The reason for the dormancy state occurred to the fish in these tests is that $CO_2$ gives a narcotic effect while it condensates with protein in the fish body.

The yellow tail at the dormancy state is sealed and stored in atmospheres of $CO_2$ and air at 30°C. One week later, the yellow tail is unsealed and cut into three pieces. Disc-shaped cut pieces of a 1.0 cm diameter at a 0.8 cm thickness are obtained from back

meat of the fish pieces. The hardness of each cut piece is then measured using a texturometer. A K value is quantitatively calculated.

| | Hardness | K value (%) | Functional test |
|---|---|---|---|
| CO2 sealed | | | Fresh and flavorful |
| Air sealed | | | Both freshness and flavor are less sufficient than those of fish sealed by $CO_2$ |

More specifically, in the case of the fish being dormant by $CO_2$ is sealed and stored with $CO_2$, the hardness of the cut pieces is higher, the K value is smaller, and the freshness and flavor are more improved than those of fish sealed and stored with air.

A result as similarly to as in yellow tail is obtained in carp also.

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